



TOA PROFESSIONAL POWER AMP

Model P-150M, P-300M



TOA ELECTRIC CO, LTD.
KOBE, JAPAN

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● Precautions

1. XLR type audio connectors are factory wired as follows.

Pins 1 and 2 are ground (shield); pin 3 is hot (high, plus).

The connector wiring changes with use of an optional matching transformer.
(Model No. PU-101T)

Pin 1 is ground (shield), Pin 2 is cold (low, minus), and pin 3 is hot (high, plus).

2. Care should be taken in making connections, selecting signal sources and controlling the output level to avoid any damage to loads.
3. Never place the two amplifier outputs parallel to each other.
4. Do not operate the amplifier from a power mains which exceeds the indicated mains voltage by more than 10%.
5. Never connect the output of the amplifier to any other power source.
6. Do not expose the amplifier to corrosive chemicals or liquids, such as soft drinks, salt water, etc.
7. Always refer the amplifier to qualified technical service personnel. There are no user servicable parts inside.

● General Description

The P-150M and P-300M are professional quality single channel (mono) power amplifiers, with 8 ohm outputs and built-in output transformers for 25-volt and 70-volt lines, designed for commercial and professional sound applications. The P-150M and P-300M deliver 150 watts and 300 watts, respectively, with 8 ohm loads or with 25-volt or 70-volt distributed system loads.

Both feature provisions for octal socket mounting of matching transformers to convert unbalanced inputs to balanced, magnetic circuit breakers, calibrated input attenuators short circuit protection circuitry, 3-second turn-on delay, current limiter protection circuitry, protection indicator LED's ground terminal strip and high pass filter. These features combine to ensure an extremely high level of reliability and durability.

Each amplifier is mechanically reinforced with a rugged front panel made of 3mm(1/8") thick cast-aluminum, and further strengthened by use of 3mm(1/8") thick steel liner, thus enabling them to withstand even the roughest use.

For easy maintenance and service, the amplifiers are built with modular, plug-in boards on a sub-chassis that can be quickly removed for repair or replacement.

● Features

- 1. Magnetic Circuit Breaker Power Switch**

Both the primary mains (A.C. line) overload protection and the on/off switch are combined into a rocker-actuated, magnetic circuit breaker whose operation, unlike fuses, is predictable and independent of temperature. Returning the switch to the "on" position resets the system.
- 2. Calibrated Input Attenuator**

A 22-step detented input attenuator is provided for easy, accurate input sensitivity adjustment. The attenuators are in 2dB steps from 0dB attenuation to -34dB, then in steps of -37dB, -42dB, -50dB, infinity. This arrangement provides a smooth, noise free transition from the highest to the lowest audio level.
- 3. Short-Circuit Protection Circuitry**

Speaker protection is provided with relay circuitry that disconnects the load whenever a short-circuit or harmful D.C. current is present across the output terminals.
- 4. 3-Second Turn-On Delay**

To help eliminate annoying clicks or pops which can occur upon turn-on in large sound systems, a three second mute/delay circuit is incorporated. The mute/delay circuit actuates the relay, and then disconnects the speaker the instant the circuit breaker is shut off.
- 5. Current Limiter Circuitry**

Protection against shorted and low impedance loads is provided with dependable current limiting as well as protection against overloaded power supplies and input overload.
- 6. Protection Indicator LED (Including Thermal Warning)**

The LED illuminates when the protection relay is activated in the following situations.

 - 1) Short-circuit
 - 2) D.C. drift
 - 3) Turn-on delay

The LED also flashes when either of two heat sinks reaches more than 105°C in temperature.
- 7. Signal Presence Indicator LED**

The LED glows when a signal greater than -30dB level is fed to the inputs regardless of the input attenuator setting and output power level. The LED is helpful in assuring sufficient input signal is fed to drive the amplifiers.
- 8. Peak Indicator LED**

The LED is actuated by means of an input/output comparator, and glows when the output signal is clipped.
- 9. Ground Terminal Strip**

Provision for isolating chassis ground from signal ground is provided on the rear panel.
- 10. Heavy Aluminum Die-Cast Panel**

The power amplifiers are constructed to withstand even the roughest use on the road. Their aluminum die-cast front panels are mountable in standard 19-inch rack. A pair of sturdy carrying handles provides protection for the front panel controls and easy handling.
- 11. Built-in Matching Transformer**

The matching transformer is provided for a constant voltage distribution system of 70 volts or 25 volts.

● Specifications (P-150M)

(DIRECT OUTPUT)

Power Output

150 watts minimum sine wave continuous average power output with 8-ohms loads over a power band from 20Hz to 20kHz. The maximum Total Harmonic Distortion (THD) at any power level from 250 milliwatts to 150 watts shall be not more than 0.1%.

220 watts minimum sine wave continuous average power output with 4-ohm loads over a power band from 20Hz to 20kHz. The maximum Total Harmonic Distortion (THD) at any power level from 250 milliwatts to 220 watts shall be not more than 0.15%.

160 watts continuous average sine wave power into 8 ohms with less than 0.1% THD, at 1 kHz.

Frequency Response

+0dB, -0.5dB, 20Hz to 20kHz

Total Harmonic Distortion

Less than 0.01% at 150 watts, 8-ohms, 1kHz

Less than 0.1% at 150 watts, 8-ohms, 20Hz to 20kHz

Intermodulation Distortion

0.05% using frequencies of 60Hz and 7kHz, mixed in a ratio of 4:1, at power output of 50 watts into 8-ohms

Input Sensitivity

An input of +4dB (1.23V), ± 0.5 dB, produces an output of 150 watts into 8-ohm, INPUT ATTENUATOR set for maximum level

Input Impedance

10k-ohms (unbalanced)

Damping Factor

Greater than 150 at any frequency from 20Hz to 1kHz

Greater than 70 at any frequency from 20Hz to 20kHz

Impedance Actual Output

Less than 0.06 ohms at any frequency from 20Hz to 1kHz

Less than 0.12 ohms at any frequency from 20Hz to 20kHz

Hum and Noise

110dB below rated output (20Hz — 20kHz)

115dB below rated output (IHF-A weighted)

Rise Time

10 microseconds, or better (10% -90% of 1 volt at 1kHz square wave output)

Slew Rate

10 volts per microsecond, or better (at 50 watts into 8-ohm, 200kHz square wave input)

Phase Shift

20Hz to 20kHz, ± 15 degrees

Offset Voltage

Less than ± 10 mV DC

Input Connectors

One "male" and one "female" XLR connector in parallel, pin 2 "cold", pin 3 "hot", and pin 1 "shield". XLR's are unbalanced and parallel to two tip-sleeve (standard) phonejacks.

Accessory Socket

8-pin octal socket accepts an optional matching transformer module for balanced input, or user options (pins include $\pm VCC$, signal input/output and circuit ground)

Output Connectors

Barrier Strip Terminal

Ground Terminal Strip

2 lug terminal block with removal shorting strap

Indicators

Green LED for signed presence

Red LED for output clipping

Red LED for circuit protection and thermal warning

Green LED for power ON.

Controls

Input Attenuator

22-position, log-linear, detented and dB-calibrated input attenuator attenuates input signal in 2dB steps from 0dB attenuation to -34dB, then in steps of -37dB, -42dB, -50dB, infinity.

Circuit Breaker AC Switch

Accessory Switch (IN/OUT)

Bypass for octal socket

Overall Protection

AC line is protected by circuit breaker.

Protection LED flash when heat sink temperature reaches more than 105°C.

Protection LED come on when the relay is activated by the DC current flow to output or by short circuit.

Turn On/Turn Off

No turn off transient. Three second delay turn on with minimum thumps and no dangerous transients

AC Line Voltage

AC mains. 50Hz/60Hz

Power Consumption

400 watts maximum

Finish

Black painting

Dimensions (W×H×D)

483 × 133 × 475 (mm)

19 × 5-1/4 × 18-3/4 (inches)

Weight

18kg (40 lbs)

SPECIFICATION (TRANSFORMER OUTPUT)

Power Output

150 watts minimum sine wave continuous average power output with either a 25-volt or 70-volt distribution system over a power band from 30Hz to 15kHz.

The maximum THD at any power level 250 milliwatts to 150 watts shall be not more than 0.6%.

Output Impedance

Designed for load impedances of 4.2-ohms (25 volts) or 33-ohm (70 volts).

● Specifications (P-300M)

(DIRECT OUTPUT)

Power Output

300 watts minimum sine wave continuous average power output with 8-ohm loads over a power band from 20Hz to 20kHz. The maximum Total Harmonic Distortion (THD) at any power level from 250 milliwatts to 300 watts shall be not more than 0.1%.

480 watts minimum sine wave continuous average power output with 4-ohm loads over a power band from 20Hz to 20kHz. The maximum Total Harmonic Distortion (THD) at any power level from 250 milliwatts to 480 watts shall be not more than 0.15%.

320 watts continuous average sine wave power into 8 ohms with less than 0.1% THD, at 1kHz.

Frequency Response

+0dB, -0.5dB, 20Hz to 20kHz

Total Harmonic Distortion

Less than 0.01% at 300 watts, 8-ohms, 1kHz

Less than 0.1% at 300 watts, 8-ohms, 20Hz to 20kHz

Intermodulation Distortion

0.05% using frequencies of 60Hz and 7kHz, mixed in a ratio of 4:1, at power output of 100 watts into 8-ohms

Input Sensitivity

An input of +4dB (1.23V), ± 0.5 dB, produces an output of 300 watts into 8-ohm, INPUT ATTENUATOR set for maximum level

Input Impedance

10k-ohms (unbalanced)

Damping Factor

Greater than 260 at any frequency from 20Hz to 1kHz

Greater than 95 at any frequency from 20Hz to 20kHz

Impedance Actual Output

Less than 0.03 ohms at any frequency from 20Hz to 1kHz

Less than 0.08 ohms at any frequency from 20Hz to 20kHz

Hum and Noise

109dB below rated output (20Hz — 20kHz)

114dB below rated output (1HF-A weighted)

Rise Time

10 microseconds, or better (10% -90% of 1 volt at 1kHz square wave output)

Slew Rate

10 volts per microsecond, or better (at 100 watts into 8-ohm, 200kHz square wave input)

Phase Shift

20Hz to 20kHz, ± 15 degrees

Offset Voltage

Less than ± 10 mV DC

Input Connectors

One "male" and one "female" XLR connector in parallel, pin 2 "cold", pin 3 "hot", and pin 1 "shield". XLR's are unbalanced and parallel to two tip-sleeve (standard) phonejacks.

Accessory Socket

8-pin octal socket accepts an optional matching transformer module for balanced input, or user options (pins include $\pm VCC$, signal input/output and circuit ground)

Output Connectors

Barrier Strip Terminal

Ground Terminal Strip

2 lug terminal block with removal shorting strap

Indicators

Green LED for signal presence

Red LED for output clipping

Red LED for circuit protection and thermal warning

Green LED for power ON

Controls

Input Attenuator

22-position, log-linear, detented and dB-calibrated input attenuator attenuates input signal in 2dB steps from 0dB attenuation to -34dB, then in steps of -37dB, -42dB, -50dB, infinity.

Circuit Breaker AC Switch

Accessory Switch (IN/OUT)

Bypass for octal socket

Overall Protection

AC line is protected by circuit breaker.

Protection LED flash when heat sink temperature reaches more than 105°C.

Protection LED come on when the relay is activated by the DC current flow to output or by short circuit.

Turn On/Turn Off

No turn off transient. Three second delay turn On with minimum thumps and no dangerous transients

AC Line Voltage

AC mains. 50Hz/60Hz

Power Consumption

850 watts maximum

Finish

Black painting

Dimensions (W×H×D)

483 × 222 × 475 (mm)

19 × 8-3/4 × 18-3/4 (inches)

Weight

28kg (62 lbs)

SPECIFICATION (TRANSFORMER OUTPUT)

Power Output

300 watts minimum sine wave continuous average power output with either a 25-volt or 70-volt distribution system over a power band from 30 Hz to 15kHz.

The maximum THD at any power level from 250 milliwatts to 300 watts shall be no more than 0.5%.

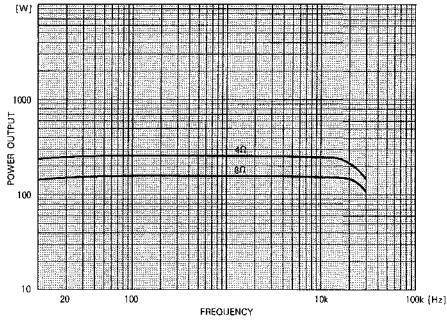
Output Impedance

Designed for load impedances of 2.1-ohms (25 volts) or 16-ohms (70 volts).

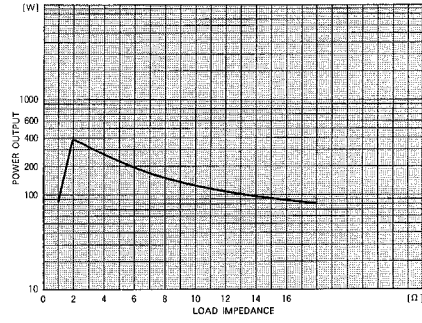
● Performance Graphs (P-150M)

P-150M DIRECT OUTPUT

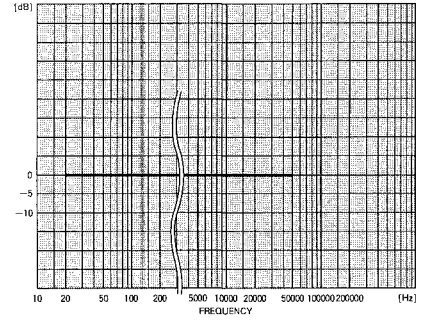
POWER BANDWIDTH



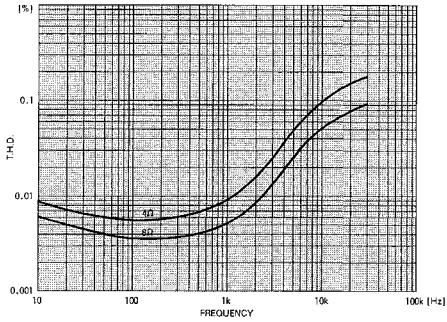
POWER OUTPUT vs LOAD IMPEDANCE



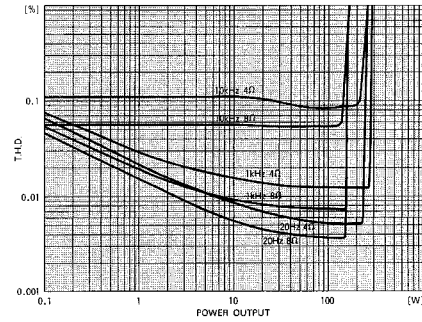
FREQUENCY RESPONSE



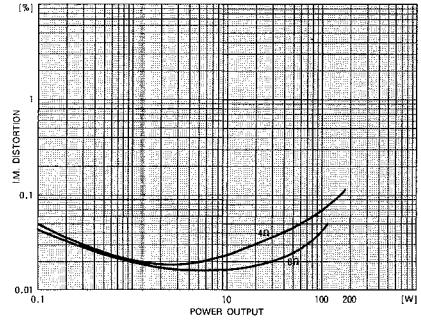
T.H.D. vs FREQUENCY



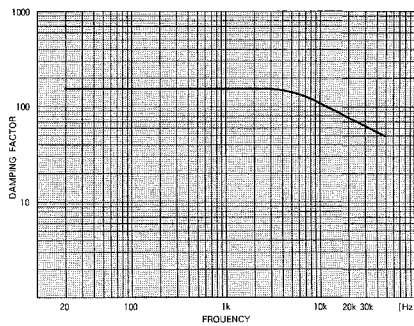
T.H.D vs POWER OUTPUT



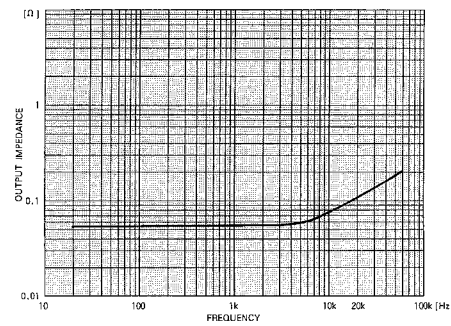
INTERMODULATION DISTORTION VS POWER OUTPUT MEASURED WITH A 4 : 1 MIX AT 60Hz and 7kHz



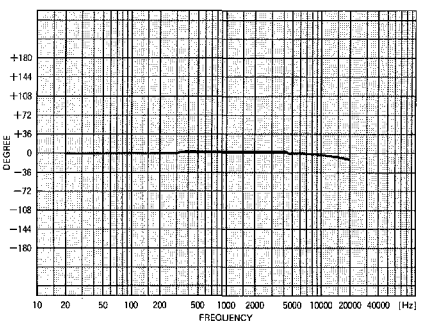
DAMPING FACTOR vs FREQUENCY AT 8 Ω LOAD IMPEDANCE



ACTUAL OUTPUT IMPEDANCE vs FREQUENCY

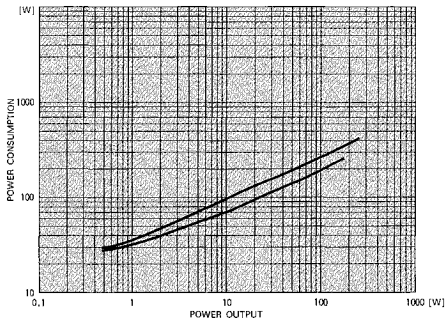


PHASE RESPONSE

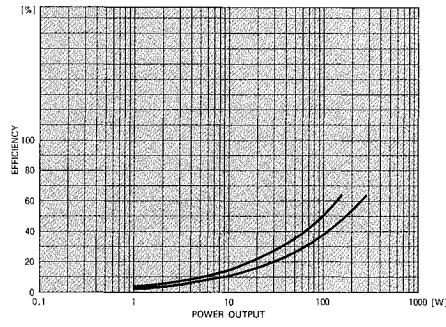


● Performance Graphs (P-150M)

POWER CONSUMPTION

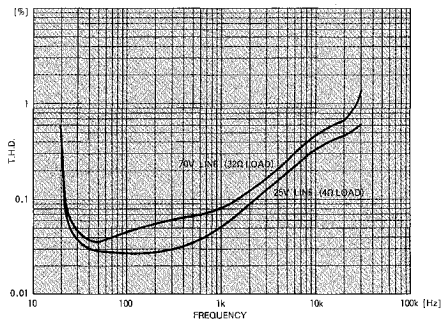


POWER EFFICIENCY

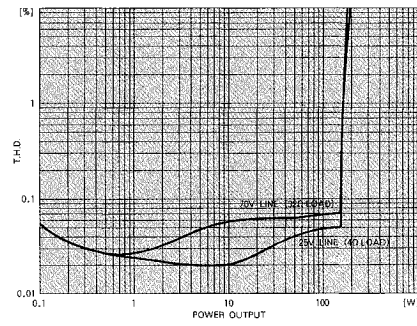


P-150M TRANSFORMER OUTPUT

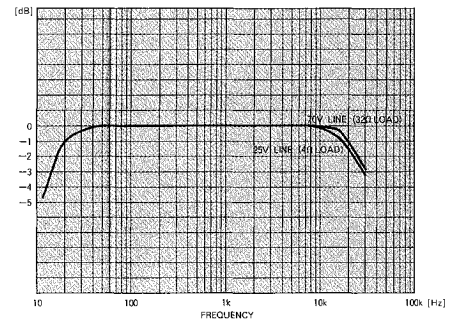
T.H.D. vs FREQUENCY



T.H.D. vs POWER OUTPUT (at 1kHz)



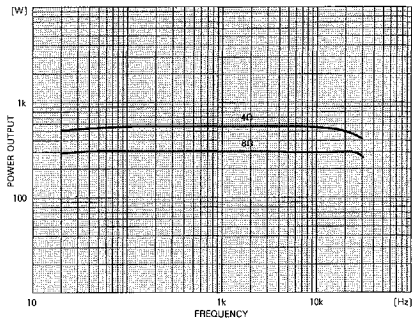
FREQUENCY RESPONSE



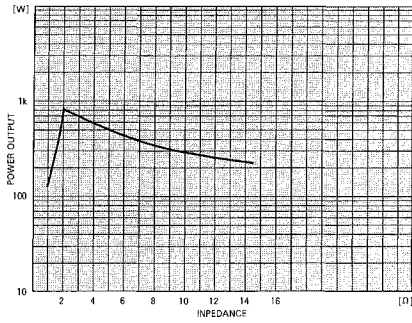
● Performance Graphs (P-300M)

P-300M DIRECT OUTPUT

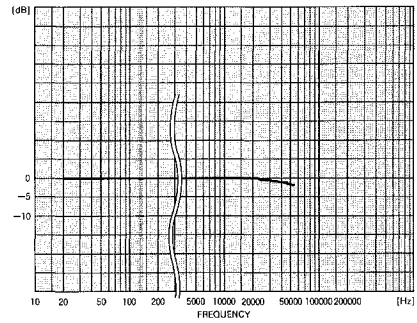
POWER BANDWIDTH



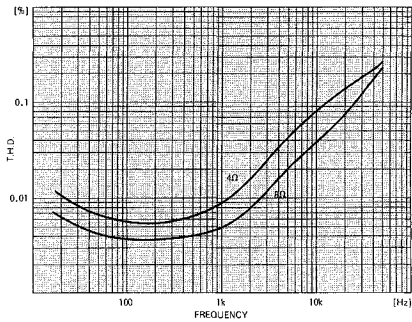
POWER OUTPUT vs LOAD IMPEDANCE



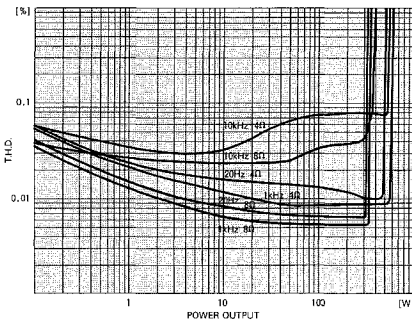
FREQUENCY RESPONSE



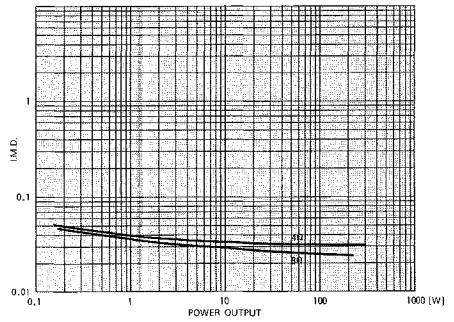
T.H.D. vs FREQUENCY



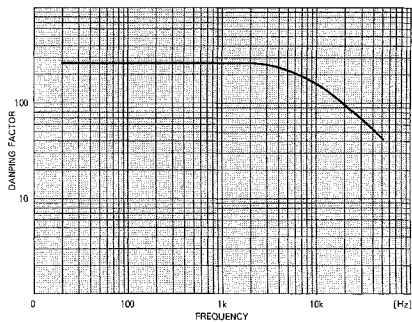
T.H.D. vs POWER OUTPUT



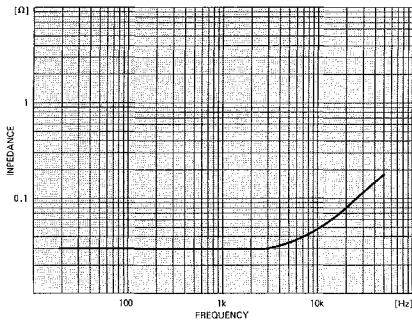
INTERMODULATION DISTORTION VS POWER OUTPUT MEASURED WITH A 4 : 1 MIX AT 60 Hz and 7 kHz



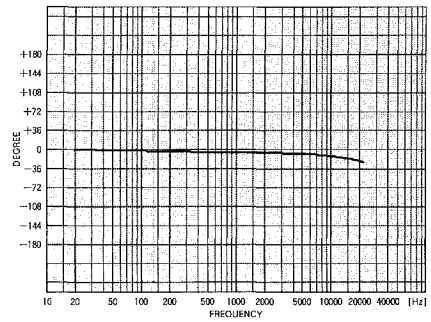
DAMPING FACTOR vs FREQUENCY AT 8 Ω LOAD IMPEDANCE



ACTUAL OUTPUT IMPEDANCE vs FREQUENCY

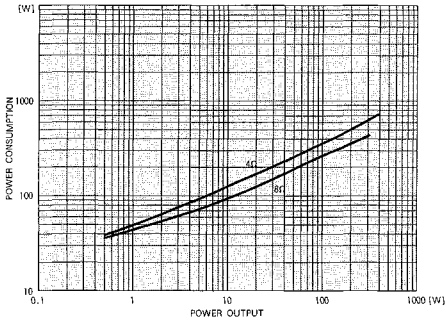


PHASE RESPONSE

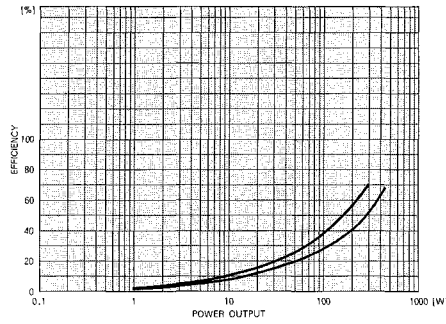


● Performance Graphs (P-300M)

POWER CONSUMPTION

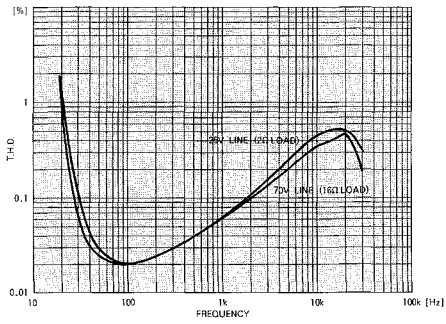


POWER EFFICIENCY

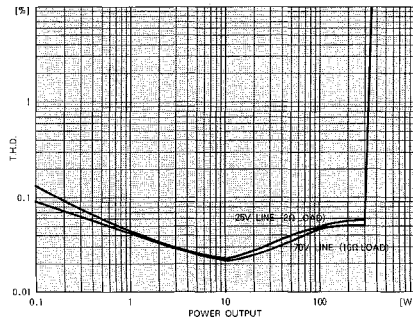


P-300M TRANSFORMER OUTPUT

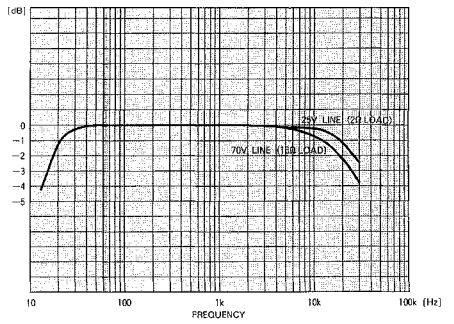
T.H.D. vs FREQUENCY



T.H.D. vs POWER OUTPUT (at 1kHz)

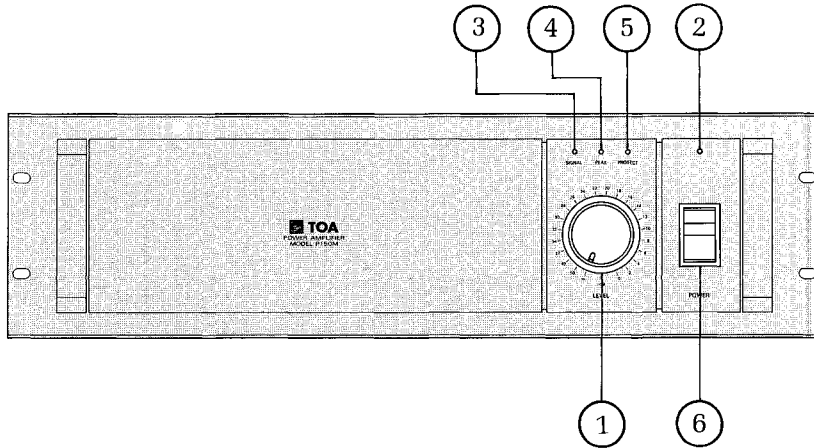


FREQUENCY RESPONSE

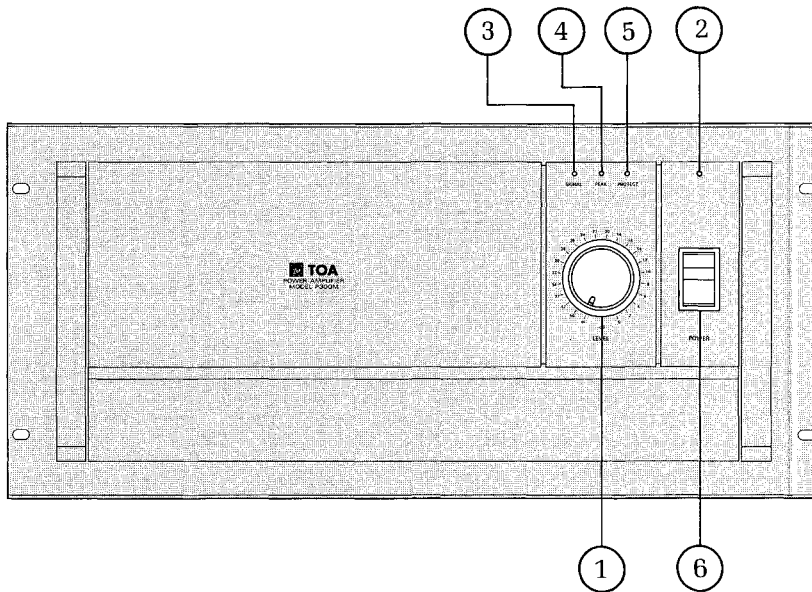


● Front Panel

P-150M



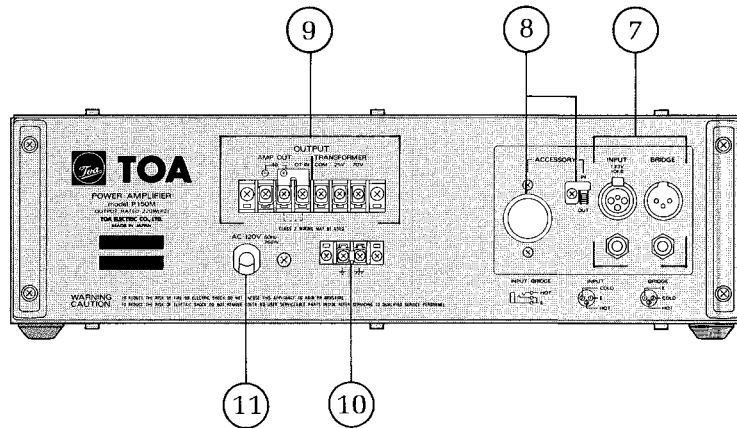
P-300M



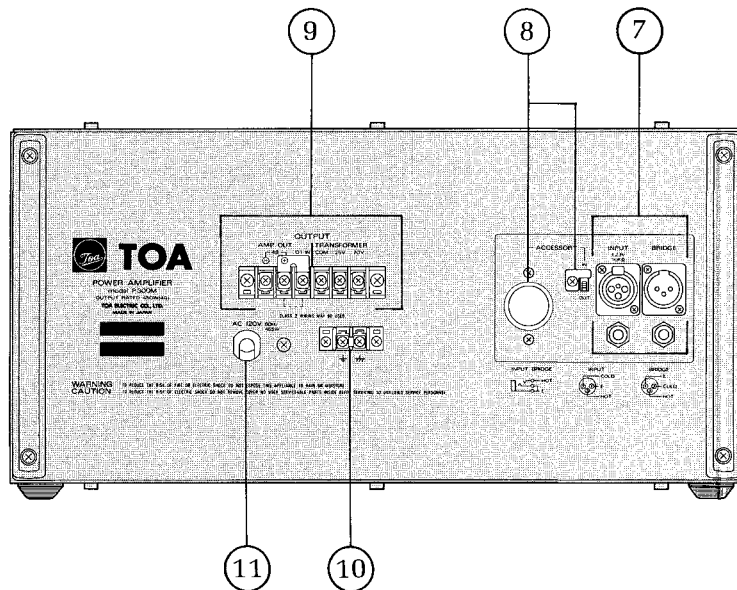
- ① **Input Attenuator**
Calibrated in dB, detented input attenuator decrease input signal levels before the amplifier stage.
- ② **Power Indicator LED**
The green LED glows when the power switch is "on".
- ③ **Signal Presence Indicator LED**
The LED glows when a signal greater than -30dB is fed to the input regardless of the input attenuator setting and output power level.
- ④ **Peak Indicator LED**
The LED glows when the output signal is clipped. In such a case, lower the input attenuator level.
- ⑤ **Protection Indicator LED**
This LED remains lit for 3 seconds after the power switch has been turned on. It also comes on when the protection circuit is activated, and flashes when the temperature of the heat sink exceeds 105°C.
- ⑥ **Circuit Breaker Power Switch**
This is a combined switch of circuit breaker and a power mains ON/OFF switch. If the circuit breaker trips, it may be reset by first setting to the "OFF" position and then returning to the "POWER ON" position. Always check the amplifier and associated wiring before resetting the circuit breaker.

● Rear Panel

P-150M



P-300M



⑦ Input connectors

The two XLR input connectors are unbalanced and wired parallel to each other with two phone jacks that can accept both a tip/sleeve and a tip/ring/sleeve type of plug.

⑧ Accessory

To convert the XLR input connectors to balanced operation, remove the octal socket cover and insert the matching transformer (PU-101T). Then loosen the screw and set the In/Out switch to "In" after removing the L-shaped metal fitting. You can prevent accidental change in switch position by attaching the metal fitting to the OUT side.

⑨ Output Connectors

Barrier strip terminals are provided for output connections of amp out (more than 4 ohms), 25-volt and 70-volt distribution systems. When applying the amp out, remove the U-shaped jumper on the strip terminals.

⑩ Ground Terminal Strip

Remove the strap to isolate chassis ground from signal ground. This may help prevent any ground loop hums caused by multiple ground paths.

⑪ AC Power Cord.

● Input/Output Connections

P-150M Typical Hookup

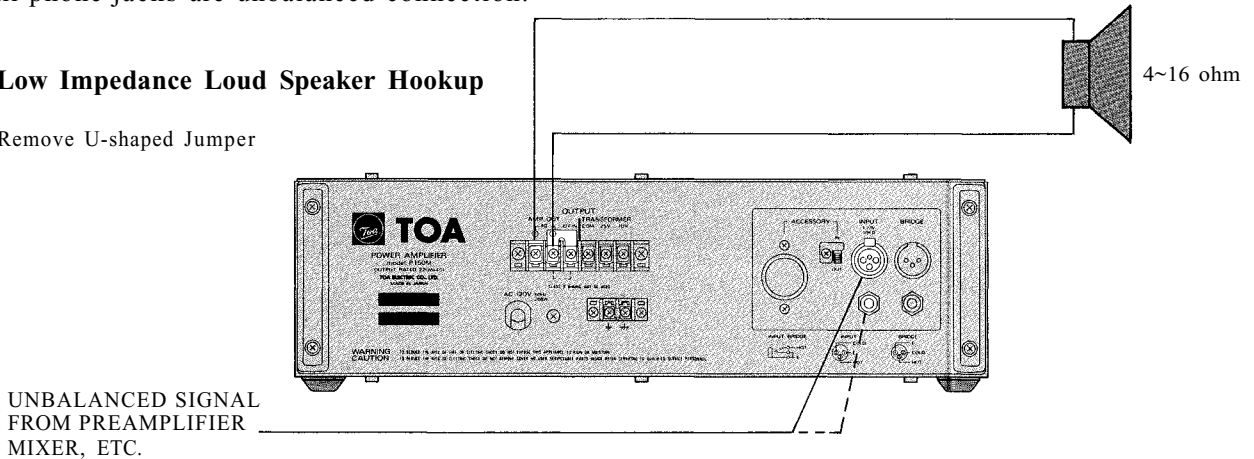
All XLR type connectors are unbalanced connection.

The pins 1 and 2 are ground (shield) the pin 3 hot (high, plus).

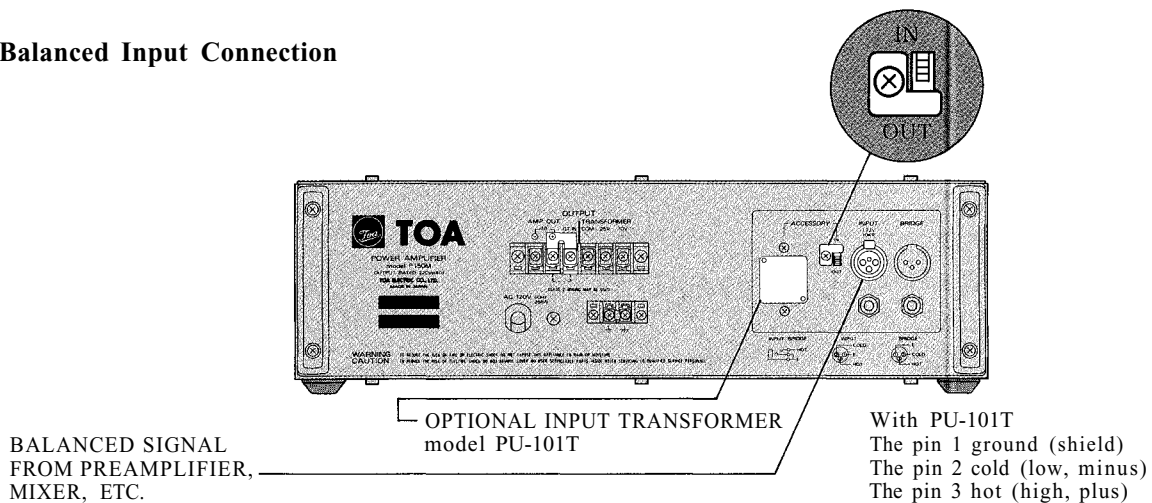
All phone jacks are unbalanced connection.

• Low Impedance Loud Speaker Hookup

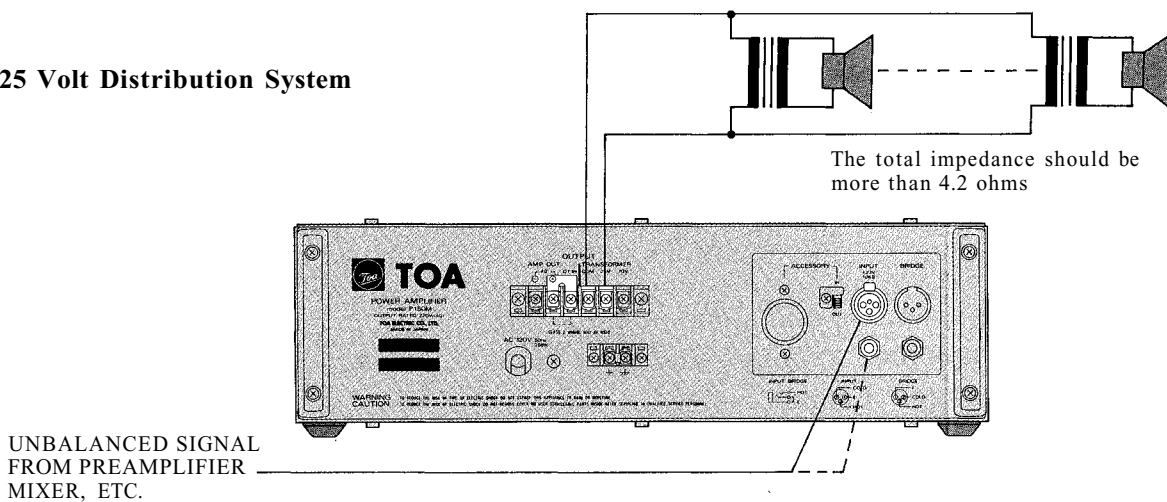
Remove U-shaped Jumper



• Balanced Input Connection



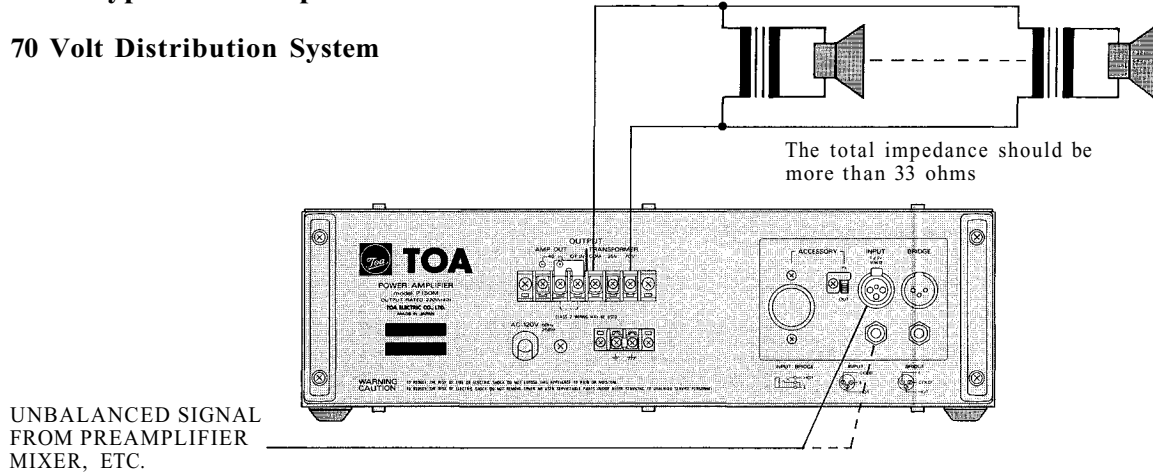
• 25 Volt Distribution System



● Input/Output Connections

P-150M Typical Hookup

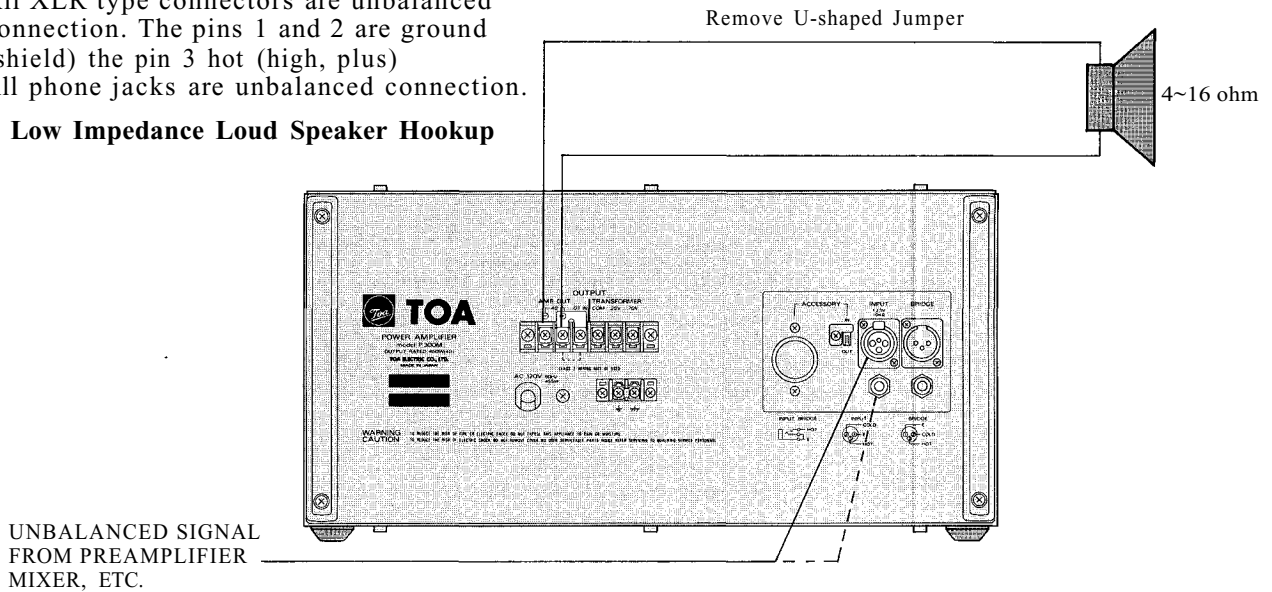
- 70 Volt Distribution System



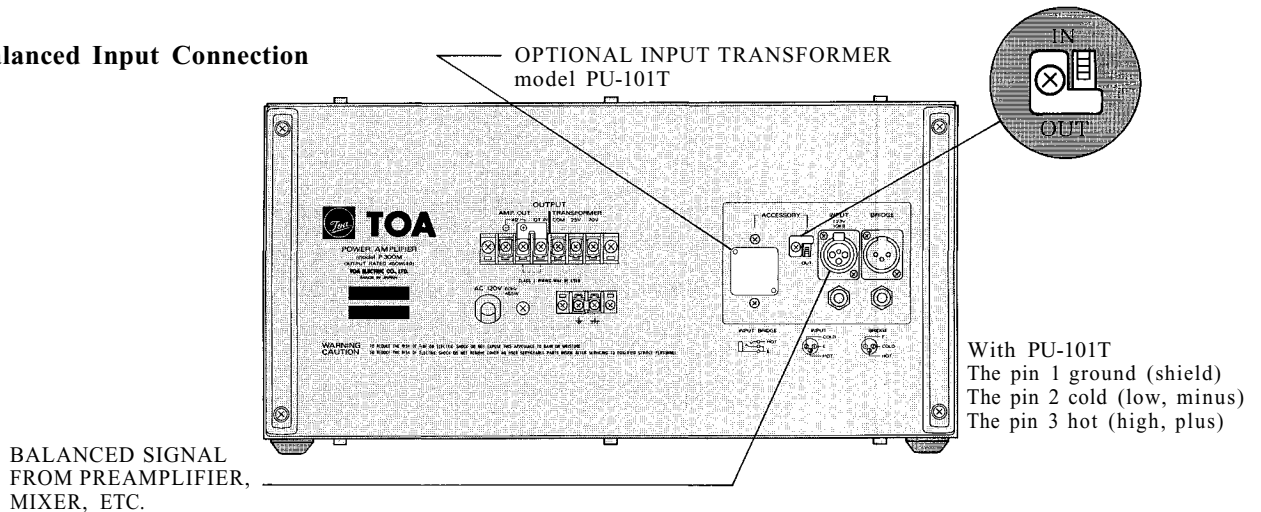
P-300M Typical Hookup

All XLR type connectors are unbalanced connection. The pins 1 and 2 are ground (shield) the pin 3 hot (high, plus)
All phone jacks are unbalanced connection.

- Low Impedance Loud Speaker Hookup



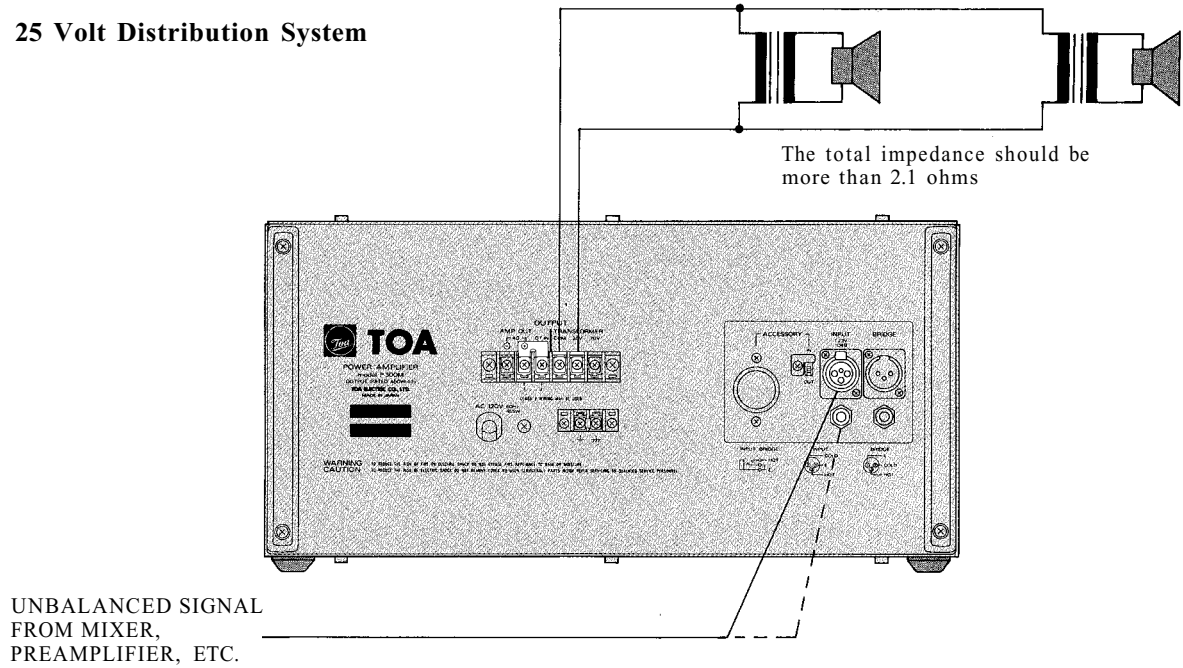
- Balanced Input Connection



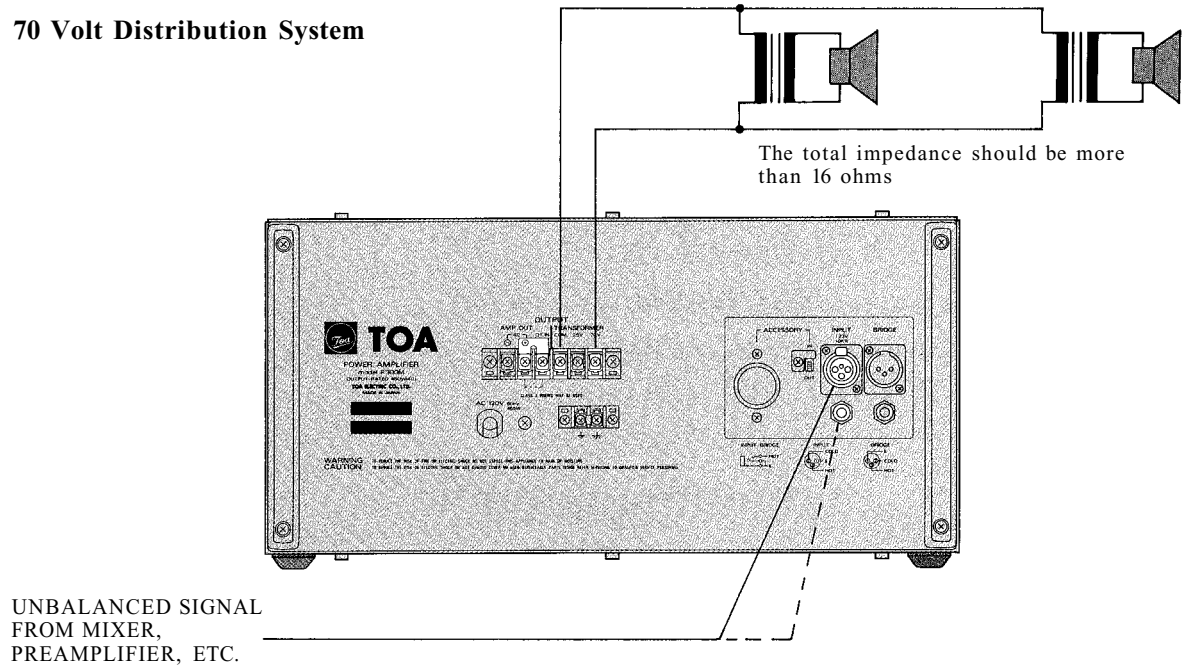
● Input/Output Connections

P-300M Typical Hookup

- 25 Volt Distribution System



- 70 Volt Distribution System



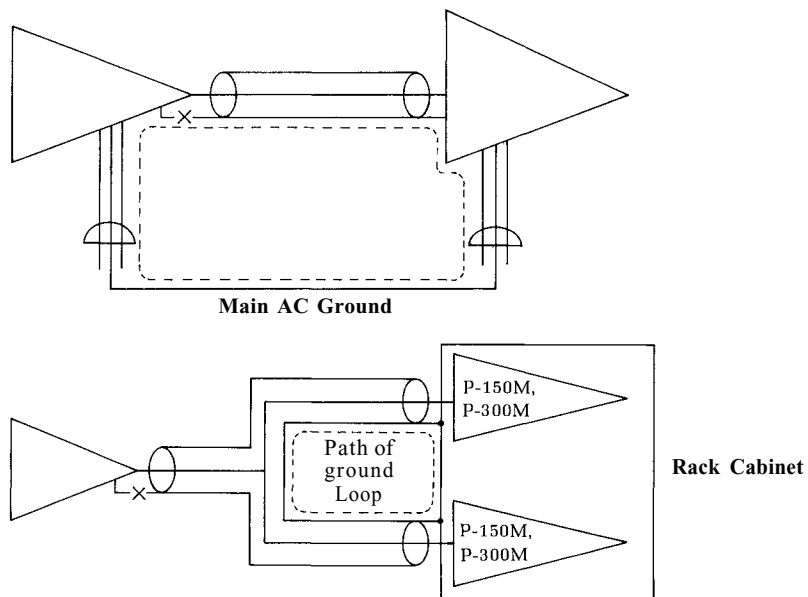
● Installation Precaution

Input and output cables

In view of high power output produced, separate the input cable from the output cable when installing the P-150M or P-300M. If they are in close proximity to each other, oscillation may occur. Particular care should be given to the wiring when mounting unit in a rack cabinet.

Ground Loop

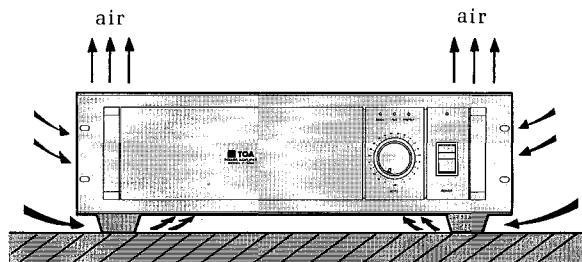
In any audio system, there are numerous ways by which ground loops can be created. For example, they may occur when the P-150M and P-300M are mounted in a rack cabinet, or through AC ground when the amps are connected with preamps and mixers. These ground loops may cause hum and noise if care is not taken during connection. An increase in noise from ground loops may be minimized by breaking the ground loop. Generally, the chassis ground of the signal line should be broken as shown below.



When a Y cord is used, shorten the wiring to minimize noise.

A ground lift terminal is provided on the rear of the P-150M and P-300M. Removing the bar in the terminals lifts ground.

Since the P-150M and P-300M are high power amplifiers, be careful with ventilation when they are installed. Do not block vents on the top panel. See sketch.



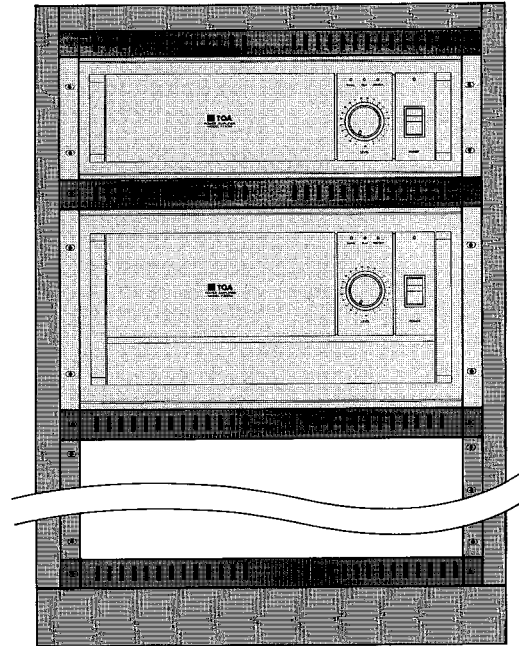
● Installation Precaution

Mounting in an enclosed rack cabinet

The P-150M and P-300M are mountable in a standard 19" rack. When mounting, insert a 1-unit-sized perforated panel between the units mounted, and place the same at the bottom of the rack. Be sure to mount a perforated panel larger than 1 unit size at the top of the rack. This is required to allow adequate heat ventilation. See illustration.

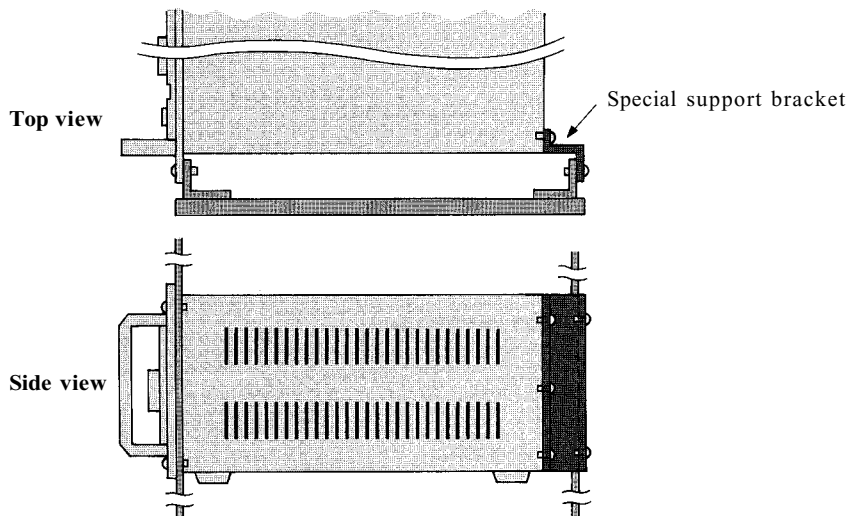
P-150M, P-300M

P-150M, P-300M



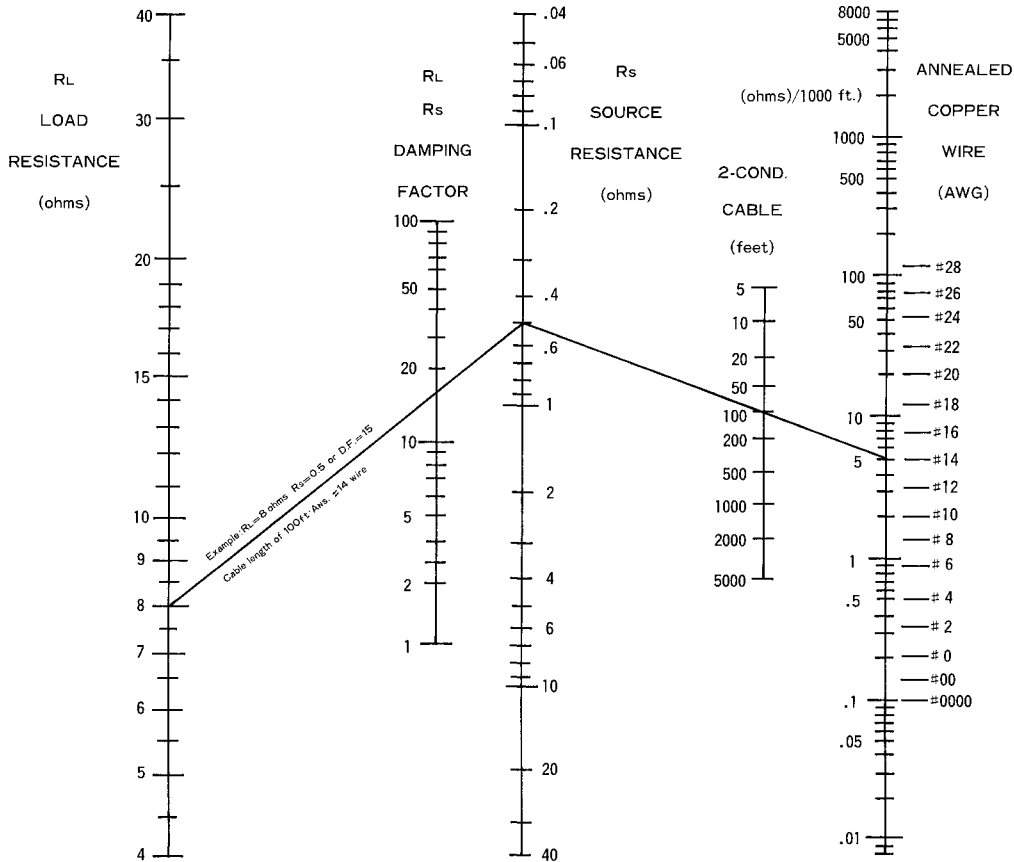
On the road use.

The P-150M and P-300M are sturdily constructed with an aluminum die-cast front panel that is reinforced by means of an iron plate attached to its back. To ensure that strength is maintained during their transportation from one place to another, however, you should also reinforce each unit from the back of the rack with a special support bracket. This can be accomplished by removing cord-hangers on the rear panel, and screws that hold the rear panel to chassis, and fitting the special support brackets through the holes.



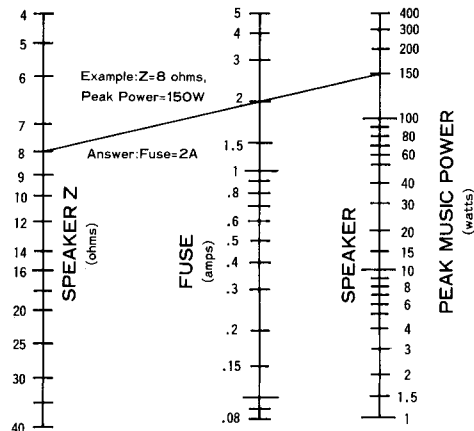
Source Resistance and Damping Factor vs. Length and Size of Output Leads

The following figure indicates that a 100 foot length of # 14 AWG annealed copper wire (two conductor) yields a combined amplifier/cable source impedance of 0.5 ohms. A typical 8 ohms load impedance is indicated, and this results in an effective damping factor of 15. (This damping factor is less than the rated one of each model obtained with zero ohms cable resistance). Larger diameter (lower wire gauge number) should be used for longer cable.



Load Protection Methods

The most common of all load protection methods is a fuse in series with the load. The fuse may be single, fusing the overall system, or (in the case of multi-element speaker systems), may be multiple with one fuse for each speaker. Fuses help prevent damage due to prolonged overload, but provide essentially no protection against damage that may be done by large transients. To minimize the problem, high speed instrumentation fuses are recommended. For a nomograph showing fuse size vs. loudspeaker ratings, refer to the following figure.



● 25/70 Volt Distribution Systems

A constant voltage distribution system is a method of connecting loudspeakers to an amplifier where the output voltage of the amplifier and the amount of power delivered to loudspeakers remain constant.

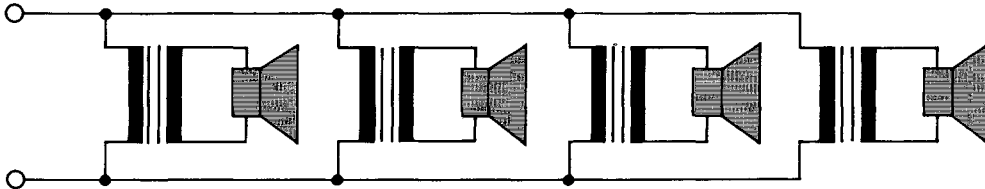
A constant voltage distribution system is similar to a power generating station that delivers electrical power to your home. Just as appliances can be turned on and off without affecting the operation of other appliances connected to the electrical system, speakers can be added to, or subtracted from, the distribution system without affecting its overall operation. However, the total number of speakers connected to the amplifier is limited by the amplifier output power capability.

The most common voltages used in a constant voltage distribution are 25 volts and 70 volts. In most areas of the USA, 70 volts is the maximum voltage that a pair of wires may carry without being enclosed in metal conduit. An amplifier that is designed for use in such a system that must develop 70 volts across the output terminal when driven to its full rated power. Actually, the output of the amplifier swings from 0 to 70 volts in response to changes in its input signal.

In a constant voltage distribution system, "Pre-Packages" speakers with matching transformers with several taps are normally utilized. (Each tap is designated in watts.) You may simply connect the output terminal of the amplifier to the tap of the power rating desired. However, if speakers without transformers are selected, the correct transformers must be carefully chosen to match the speakers. Transformers are usually designed for a specific constant voltage level (i.e. 70 volts and 25 volts), and have primary winding taps rated in watts, and secondary winding taps rated in ohms. They may have several primary and secondary winding taps.

Primary windings of the transformer are connected in parallel across the output terminals of the amplifier, while secondary windings are connected across a loudspeaker or loudspeaker system. Secondary winding taps are chosen to match the impedance of the loudspeaker. Primary winding taps should be selected to match the power that a speaker receives. An amplifier's output voltage will determine the power delivered to a speaker.

Transformers are connected in parallel across the output terminals of the amplifier.



Primary windings of certain transformers are rated in ohms instead of watts. To select a transformer for a specific power level, the following formula can be used:

$$Z = \frac{E^2}{P} \text{ where } \begin{array}{l} Z \text{ is the impedance of the primary winding of the transformer (ohms)} \\ E \text{ is the constant voltage level of the system} \\ P \text{ is the desired power (watts)} \end{array}$$

For a 70 volt system, where 5 watts are desired at a particular speaker, the primary winding of the transformer must have an impedance of:

$$Z = \frac{5000}{5} = 1000 \text{ ohms.}$$

Note: 70^2 is approximately 5000

● 25/70 Volt Distribution Systems

Two important factors must be considered when setting up a constant voltage distribution system.

1. The rated power of an amplifier must be higher than the total power that the speakers receive.
2. The total impedance of the speaker system must be kept above the minimum value to ensure constant voltage operation. This impedance can be calculated by the following formula:

$$Z = \frac{E^2}{P} \quad \text{where } Z \text{ is the total impedance of the speaker system (ohms)}$$

$$E \text{ is the output voltage of the amp at full power}$$

$$P \text{ is the full rated power of the amplifier (watts)}$$

For a 50-watt amplifier to power a 70 volt system, the minimum impedance is:

$$Z = \frac{(70)^2}{50} = \frac{5000}{50} = 100 \text{ ohms} \quad (70)^2 \text{ is approximately } 5000$$

CONSTANT VOLTAGE LINES WATTS VS OHMS VS VOLTS

WATTS	25V	70V	100V	4Ω	8Ω	16Ω
25	25.0	196.0	400.0	10.0	14.1	20.0
50	12.5	98.0	200.0	14.1	20.0	28.3
75	8.33	65.3	133.3	17.3	24.5	34.6
100	6.25	49.0	100.0	20.0	28.3	40.0
125	5.00	39.2	80.0	22.4	31.6	44.0
150	4.17	32.7	66.7	24.5	34.6	49.0
175	3.57	28.0	57.1	26.5	37.4	52.9
200	3.13	24.5	50.0	28.3	40.0	56.6
225	2.78	21.8	44.4	30.0	42.4	60.0
250	2.50	19.6	40.0	31.6	44.7	63.3
300	2.08	16.3	33.3	34.6	49.0	69.3
400	1.56	12.3	25.0	40.0	56.6	80.0
500	1.25	9.8	20.0	44.7	63.3	89.5
600	1.04	8.2	16.7	49.0	69.3	98.0
700	0.89	7.0	14.3	53.0	74.8	105.8
750	0.83	6.5	13.3	54.8	77.5	109.5
800	0.78	6.1	12.5	56.6	80.0	113.1

└────────── Ohms ─────────┘

└────────── Volts ─────────┘

$$E = \sqrt{PR} \quad E = \text{volts}$$

$$P = E^2/R \quad P = \text{watts}$$

$$R = E^2/P \quad R = \text{resistance}$$

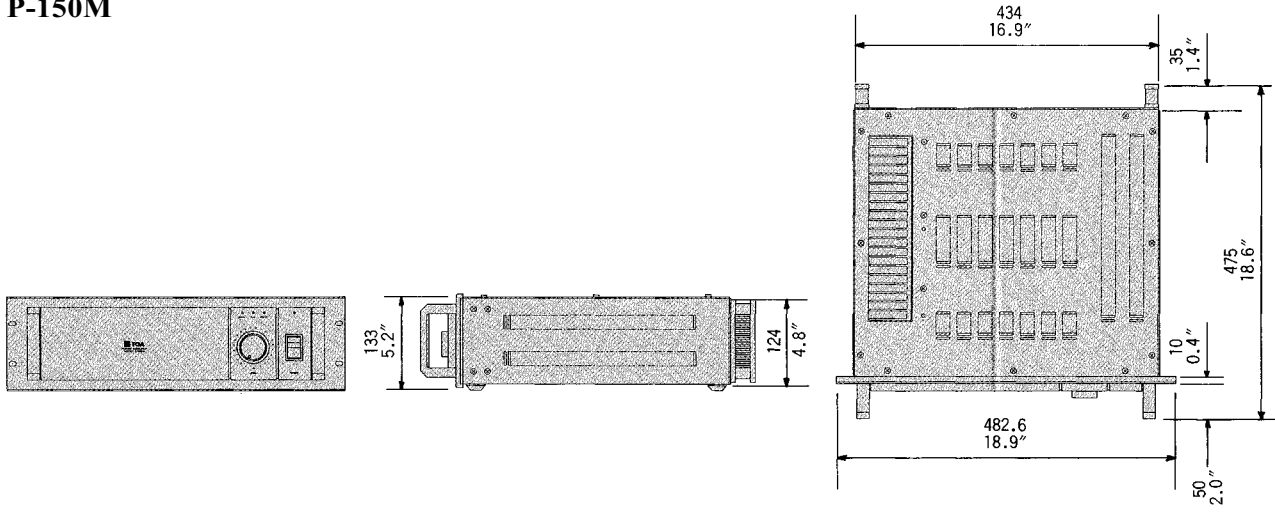
To use chart you will have two of the known values: ohm, volts or watts. On the first horizontal line select one known value-watts, constant volts or resistance. Then move down the column until you find the second known value. Then move horizontally to the unknown value.

Example 1 70V constant line and 49 ohms = 100 watts

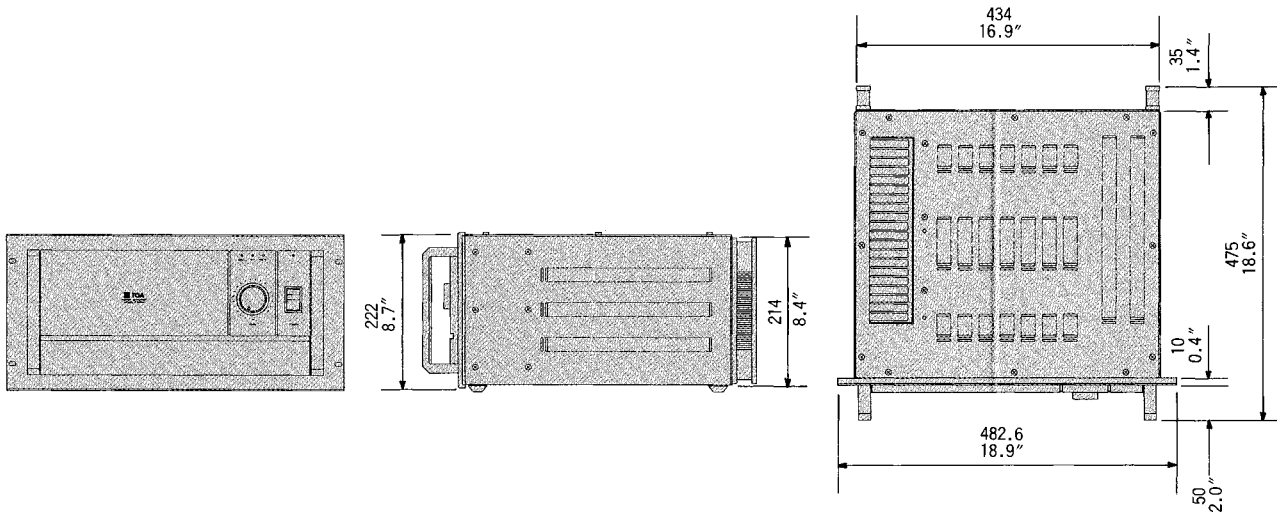
Example 2 16 ohms and 60 volts = 225 watts

● Appearance

P-150M



P-300M





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